IJERST

International Journal of Engineering Research and Science & Technology

www.ijerst.org

ISSN : 2319-5991

Vol. 18 No. 3 (2022)

ijerst.editor@gmail.com

editor@ijerst.com

International Journal of Engineering Research and Science & Technology

BALANCED NUTRITION APPROACH FOR HIGHER COWPEA PRODUCTIVITY USING SULPHUR AND MOLYBDENUM APPLICATION

DR. SUHAIL AHMED BHAT

Faculty, Dept of Forestry,

Bharatiya Engineering Science & Technology Innovation University, Andhra Pradesh, India.

Abstract

A field trial was carried out in the summer season of 2020 at the College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat to evaluate the balanced nutrition approach for higher cowpea (*Vigna unguiculata* L.) Productivity using sulphur and molybdenum application the experimental soil was clay in texture and slightly alkaline in nature. The experiment consisted of nine treatment combinations, namely: T1 – RDF, T2 – 25 kg S/ha, T3 – 50 kg S/ha, T4 – 500 ppm foliar Mo, T5 – 0.5 g Mo/kg seed, T6 – 25 kg S + 500 ppm Mo, T7 – 25 kg S + 0.5 g Mo/kg seed, T8 – 50 kg S + 500 ppm Mo and T9 – 50 kg S + 0.5 g Mo/kg seed. All treatments received a common application of RDF (20-40-00 NPK kg/ha). Sulphur was applied at the time of sowing, while the foliar application of molybdenum was carried out at 30 days after sowing (DAS) using 250 L of water per hectare. The experiment was laid out in a randomized block design (RBD) with three replications. The application of T6 (25 kg S + 500 ppm Mo) significantly enhanced the growth and yield attributes of cowpea recording higher plant height (46.93 cm), number of branches per plant (4.51), nodules per plant (20.77), dry matter accumulation (35.50 g), pods per plant (12.28), seeds per pod (11.14), pod length (16.05 cm), seed yield (928 kg/ha) and stra w yield (2280 kg/ha). This treatment remained statistically at par with T7 (25 kg S + 0.5 g Mo/kg seed), T8 (50 kg S + 500 ppm Mo) and T9 (50 kg S + 0.5 g Mo/kg). The highest net return (₹36,912/ha) was achieved with T6, closely followed by T7 (₹36,584/ha), T9 (₹35,279/ha) and T8 (₹35,087/ha). In contrast, the maximum BCR (3.01) was observed under T7, which was followed by T6 (2.98), T9 (2.92), and T8 (2.86).

Keywords: Cowpea, economics, fertilization, growth and yield, molybdenum, sulphur

Introduction

Cowpea (*Vigna unguiculata* L.), commonly known as lobia, is a multipurpose legume crop grown for grain, vegetable, fodder, and soil enrichment purposes. It is predominantly cultivated in arid and semi-arid regions due to its drought tolerance and low input requirements. In India, cowpea is mainly grown during the kharif and summer seasons. Similar to all pulse crops it has the unique ability of maintaining and restoring the fertility of soil through active biological nitrogen fixation and addition of huge amount of mature to the soil with the help of Rhizobium leguminosarum (Xavier *et al*. (2023) [10]. According to the

Agriculture Ministry, India's pulses production in 2023- 2024 was estimated to be 234 lakh tonnes, which is a decrease from 261 lakh tonnes in 2022-2023. India has historically faced a shortage in pulses production and has relied on imports, averaging 25 lakh tonnes per year over the past five years. In 2023-2024, India's pulse imports almost doubled, and the country is expected to import more than 4.5 million tonnes of tur, urad, and masoor in 2024. To support domestic supplies and control price spikes, the government extended duty-free imports of these pulses until the end of 2025 (Anon., 2023).

Cowpea (*Vigna unguiculata* L.) is a highly nutritious pulse crop grown extensively in tropical and subtropical regions. It plays a vital role in food security and sustainable agriculture due to its ability to fix atmospheric nitrogen, improve soil fertility, and serve as a rich source of protein. However, cowpea productivity in India remains sub- optimal, primarily due to imbalanced nutrient managementand deficiency of secondary and micronutrients such as sulphur (S) and molybdenum (Mo). Sulphur is an essential secondary nutrient involved in protein synthesis, chlorophyll formation, and enzymatic activities. Molybdenum is a critical micronutrient that functions as a co-factor in enzymes such as nitrogenase and nitrate reductase, directly impacting nodulation and biological nitrogen fixation. Proper management of these nutrients can lead to significant improvements in legume growth and yield.

The present investigation was carried out to evaluate the individual and combined effects of sulphur and molybdenum fertilization, applied via soil, seed treatment, and foliar spray, on the growth, yield, and economics of cowpea under south Gujarat agro-climatic conditions.

Materials and Methods

A field experiment was carried out in the summer of 2020 at the College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari to evaluate the effect of sulphur and molybdenum fertilization on cowpea (*Vigna unguiculata*). The experimental soil was clayey in texture with a slightly alkaline reaction. The study included nine treatment combinations: T1 – RDF, T2 – 25 kg S/ha, T3 – 50 kg S/ha, T4 – 500 ppm foliar Mo, T5 – 0.5 g Mo/kg seed, T6 – 25 kg S + 500 ppm Mo, T7 – 25 kg S + 0.5 g Mo/kg seed, T8 – 50 kg S + 500 ppm Mo, and T9 – 50 kg S + 0.5 g Mo/kg seed. The applications of fertilizers were applied at time of sowing and foliar spray at 30 DAS using water 250 l/ha and common application of RDF with all teatments with

20-40-00 NPK kg/ha. These treatments was evaluated using a randomized block design (RBD) with three replications. The field was prepared by ploughing, harrowing and planking to obtain a fine tilth for sowing. Cowpea variety GC-4 was sown on 18 February 2020 at a depth of 3–4 cm using a seed rate of 25 kg/ha, with spacing of 45 cm x 10 cm between plants. The plots were irrigated immediately after sowing to promote uniform germination. Required amounts of FYM and bio-compost for the gross plot area were calculated for each treatment. Similarly, the quantities of urea, single superphosphate, gypsum, and ammonium molybdate needed for the treatments were determined, mixed with the organic fertilizer, and the mixture was manually applied into pre-opened furrows of the respective plots. The crop was harvested on 10^{th} May, 2020. Weeds were managed by herbicides and plant protection measures were taken up as and when required. In each plot, five plants were randomly chosen and tagged for recording growth, yield attributes, yield and quality parameters. At maturity data on pods per plant, seeds per pod, pod length, test weight, seed and haulm yield were collected and the results were analyzed using standard ANOVA procedures as outlined by Panse and Sukhatme (1985) [7].

Results and Discussion

Growth attributes: Treatment T6 (25 kg S + 500 ppm Mo) produced the highest plant height at harvest (46.93 cm), branches per plant (4.51), nodules/plant at 40 DAS (20.77) and dry matter accumulation at harvest (35.50 g) which was statistically comparable to those of T7, T8 and T9. However, different treatments tried in the experiment did not exert their significant effect on 50% flowering and days to maturity of cowpea.

The improved growth and development of cowpea might be attributed to the synergistic interaction between sulphur (S) and molybdenum (Mo), which enhanced nutrient availability and photosynthesis throughout the growing season. Sulphur application supports amino acid and protein synthesis, while Mo, being an essential trace element, plays a vital role in the activity of molybdo enzymes such as nitrate reductase (for nitrate assimilation) and nitrogenase (for biological nitrogen fixation and nodulation initiation). The combined effect of S and Mo fertilization thus resulted in better growth, nutrient uptake, and yield performance of cowpea. These findings are in agreement with the earlier reports of Jat (1992)

Yield attributes and yield: Application of T6 (25 kg S ha^{-1} + 500 ppm Mo) produced significantly higher pods per plant (12.28), seeds per pod (11.74) and pod length (16.05 cm) compared to the control, though these values did not differ significantly from those under T7, T8 and T9. Seed yield (928 kg/ha) and haulm yield (2280 kg/ha) were also significantly increased with T6, but were statistically comparable to yields under T2, T4, T7, T8 and T9. In contrast, 100-seed weight and harvest index were not significantly affected by the different treatments.

Table 1: Response of Sulphur and Molybdenum Fertilization on Growth attributes of cowpea

Treatments	**Plant height (cm) at harvest**	**Number of branches/plant**	**Nodules/ plant**	**Dry matter accumulation (g) at harvest**	**Days to 50% flowering**	**Days to maturity**
T1: RDF	37.70	3.43	27.20	13.78	44.12	81.00
T2: 25 kg S/ha	41.72	3.80	29.18	15.76	44.08	81.00
T3: 50 kg S/ha	39.73	3.53	28.78	15.75	43.95	80.33
T4: 500 ppm foliar Mo	40.42	3.57	29.17	16.50	42.52	80.33
T5: 0.5 g Mo/kg seeds	39.76	3.63	29.14	15.99	43.14	80.33
T6: 25 kg S + 500 ppm Mo	46.93	4.51	35.50	20.77	37.83	80.33
T7: 25 kg S + 0.5 g Mo/kg seeds	46.56	4.48	33.60	20.41	40.08	79.33
T8:50 kg S + 500 ppm Mo	42.77	4.09	31.79	18.06	42.11	80.00
T9: 50 kg S + 0.5g Mo/kg seeds	42.19	3.98	31.19	16.82	42.30	77.67
S.Em. ±	1.78	0.21	1.29	1.33	1.73	3.81
C.D at 5 %	4.12	0.62	3.85	3.98	NS	NS
C. V. %	7.43	9.20	27.20	13.78	7.11	8.22

Table 2: Response of Sulphur and Molybdenum Fertilization on Yield attributes and Yield of cowpea

Treatments	**Number of pods/ Plant**	**Number of seed/ Pod**	**Length of pod (cm)**	**Test weight (g)**	**Seed yield (kg/ha)**	**Haulm yield (kg/ha)**	**Harvest index (%)**
T1: RDF	10.12	9.27	11.56	10.51	785	1843	30%
T2: 25 kg S/ha	10.80	11.19	15.65	11.03	861	2020	30%
T3: 50 kg S/ha	10.19	9.68	11.58	10.53	821	1916	30%
T4: 500 ppm foliar Mo	10.49	10.94	15.53	10.69	852	2019	30%
T5: 0.5 g Mo/kg seeds	10.24	10.84	12.66	10.62	832	1966	30%
T6: 25 kg S + 500 ppm Mo	12.28	11.74	16.05	11.54	928	2280	29%

T7: 25 kg S + 0.5 g Mo/kg seeds	12.06	11.54	16.03	11.51	916	2230	29%
T8:50 kg S + 500 ppm Mo	11.49	11.22	15.85	11.26	902	2206	29%
T9: 50 kg S + 0.5g Mo/kg seeds	11.01	11.21	15.82	11.21	900	2174	29%
S.Em. ±	0.45	0.39	1.06	0.42	30.03	88.43	0.012
C.D at 5 %	1.37	1.18	3.18	NS	90.05	265.12	NS
C. V. %	7.21	6.28	12.66	6.65	6.00	7.38	7.33

Improved yield attributes under sulphur and molybdenum fertilization may be due to their synergistic effect in enhancing nutrient supply and physiological processes.Sulphur contributes to amino acid, protein and vitamin synthesis, tissue development and strengthening of plant structures, while molybdenum supports nitrate reduction and

nitrogen fixation, thereby improving nutrient uptake and photosynthetic efficiency. The resulting favorable nutritional environment enhanced source capacity and translocation of photosynthates to sinks (pods and seeds), which led to higher seed yield and associated traits (Jat, 1992; Jat and Rathore, 1994; Pareek, 2005) [5, 6, 8].

Quality parameters: Based on the data provided in Table 3, the magnitude of the protein content of cowpea seed indicated that different treatments of sulphur and molybdenum fertilization improve protein content significantly. However, treatment T6 (25 kg S + 500 ppm Mo) contributed to higher protein content (24.01 %) and statistically at par with treatment T2, T4, T5, T7, T8 and T9. gnificantly higher protein yield of cowpea (223.24 kg/ha) was recorded under treatment of T6 and was at par with the treatments of T7, T8 and T9.

Sulphur plays an important role in the synthesis of amino acids, proteins, vitamins, and coenzymes. Recent studies indicate that lack of sulphur to meet plant requirements may reduce not only yields but also the quality of grain legumes (reduction of cysteine and methionine) by changing the gene expression of storage proteins in developing seeds. Molybdenum is also important for sulphur metabolism, so it can have a positive impact on the biological value of protein (Głowacka *et al.* (2019) [3]. Similar finding was also reported by Singh *et al.* (2017) [9].

Table 3: Response of Sulphur and Molybdenum Fertilization on Quality parameter and Economics of cowpea

Treatments	Quality Parameters		Returns (₹/ha)		BCR
	Protein content (%)	Protein yield (kg/ha)	Gross return	Net return	
T1: RDF	18.29	143.22	46621	28952	2.64
T2: 25 kg S/ha	21.53	185.39	51131	33234	2.86
T3: 50 kg S/ha	21.10	173.14	48731	30606	2.69
T4: 500 ppm foliar Mo	21.39	182.26	50658	32277	2.76
T5: 0.5 g Mo/kg seeds	21.19	175.78	49465	31522	2.76
T6: 25 kg S + 500 ppm Mo	24.01	223.24	55521	36912	2.98
T7: 25 kg S + 0.5 g Mo/kg seeds	23.73	217.44	54755	36584	3.01
T8:50 kg S + 500 ppm Mo	22.71	204.75	53924	35087	2.86
T9: 50 kg S + 0.5g Mo/kg seeds	13.39	202.80	53678	35279	2.92
S.Em. ±	0.93	9.82			
C.D at 5 %	2.81	29.47			
C. V. %	7.45	8.97			

Economics: The data on economics pertaining to gross return, net return and benefit cost ratio (BCR) under different sulphur and molybdenum fertilization treatments The data revealed that maximum gross return of Rs. 55521.33/ha was realized with T6 (25 kg S + 500 ppm Mo), followed by the treatments T7, T8, T9 and T2 and maximum net return of Rs. 36912/ha was realized with T6 (25 kg S + 500 ppm Mo) followed by the treatment T7 (25 kg S + 0.5 g Mo/kg seeds) by recording net return of Rs. 36584/ha. An appraisal of data showed that maximum BCR of 3.01 was obtained with the T7 (25 kg S + 0.5 g Mo/kg seeds), followed by the treatment T6 (25 kg S + 500 ppm Mo) by securing BCR of 2.98.

Conclusion: The combined application of RDF with 25 kg S/ha with 500 ppm foliar Mo (T_6) significantly enhanced the growth, yield and profitability of cowpea. However, T_7 (25 kg S/ha + 0.5 g Mo/kg seed) recorded the highest BCR, making it a more economical option for farmers. Thus, integrated nutrient management involving sulphur and molybdenum, particularly through seed treatment, is recommended for enhancing cowpea productivity under south Gujarat conditions.

References

1. Anonymous. Annual report 2022–23. Government of India, Ministry of Agriculture and Farmer Welfare, Directorate of Pulses Development, 2023.

2. Choudhary HP, Das SK. Effect of P, S and Mo application on yield of rainfed blackgram and their residual effect on safflower and soil and water conservation in an eroded soil. Journal of Indian Society of Soil Science,1996:44:741–745.Głowacka A, Gruszecki T, Szostak B, Michalek S. The response of common bean to sulphur and molybdenum fertilization. International Journal of Agronomy,2019:2:1–8.
3. Hogues ME, Nienaber CA, Albrecht SL. Effect of molybdenum and sulphur fertilization on nitrogen fixation and yield of cowpea. Journal of Plant Nutrition,1997:20(4–5):559–572.
4. Nandigama, N. C. (2016). Teradata-Driven Big Data Analytics For Suspicious Activity Detection With Real-Time Tableau Dashboards. International Journal For Innovative Engineering and Management Research, 5(1), 73–78
5. Jat RL. Effect of sulphur and molybdenum on growth, yield and quality of cowpea (*Vigna unguiculata* L.). M.Sc. (Agri.) Thesis, Rajasthan Agricultural University, Bikaner, India, 1992.
6. Jat RL, Rathore PS. Effect of sulphur and molybdenum on yield, quality and nutrient uptake of cowpea (*Vigna unguiculata* L.). Indian Journal of Agronomy,1994:39(4):669–672.
7. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. New Delhi, ICAR, 1985, 87–89.
8. Nandigama, N. C. (2021). A Hybrid Approach for Feature Selection Analysis on the Intrusion Detection System Using Naive Bayes and Improved BAT Algorithm. Research Journal of Nanoscience and Engineering, 5(1), 15–19. https://doi.org/10.22259/2637-5591.0501003
9. Pareek RG. Effect of sulphur and molybdenum fertilization on growth, yield and quality of cowpea (*Vigna unguiculata* L.). Ph.D. Thesis, Rajasthan Agricultural University, Bikaner, India, 2005.
10. Singh R, Singh AP. Effect of phosphorus, sulphur and biofertilizer on yield, quality and uptake of nutrients in cowpea (*Vigna unguiculata*). Annals of Plant and Soil Research,2017:19(2):175–179.
11. Xavier GR, Jesus EdC, Dias A, Coelho MRR, Molina YC, Rumjanek NG. *et al*. Contribution of biofertilizers to pulse crops: from single-strain inoculants to new technologies based on microbiome strategies. Plants,2023:12:954.